

The Superfund Program and Its Types of Costs

The federal Superfund program to clean up the nation's worst hazardous waste sites was created by the Congress in 1980, partly in response to reported threats to human health and the environment at the Love Canal site in Niagara Falls, New York. The problem of cleaning up waste hazards has proved to be larger and more expensive than the Congress originally expected, and the end is not yet in sight. During its first 12 years, the Superfund program completed close to 2,500 removal actions, which include responses to emergencies such as chemical spills and leaking barrels and interim steps to eliminate the immediate threats posed by more complex hazards. The program also placed 1,275 sites on the National Priorities List (NPL) for longer and more extensive remedial cleanups. But despite public and private spending of more than \$13 billion through 1992, only 149 of the 1,275 NPL sites had completed all construction work related to the cleanup remedies, and just 40 had been fully cleaned up. Furthermore, estimates of the ultimate number of NPL sites range between 2,100 and 10,000.¹

The potential size of the Superfund program raises important questions about its likely costs and benefits. To shed some light on these questions, this study estimates the future costs to the public and

private sectors of Superfund cleanups at all sites not owned by the federal government. (The costs of cleaning up federal facilities are borne not by the Superfund program but by the agencies that operate the sites--principally the Departments of Energy, Defense, and the Interior--and pose some different policy issues.)² This study does not try to estimate the benefits of cleanup; a 1991 report by the National Research Council suggested that reliable estimates of the benefits may not be possible given the present state of toxicological knowledge.³

Superfund in Brief

The Superfund law is the broadest federal statute governing cleanup of waste hazards--or, more formally, sites contaminated with hazardous sub-

1. See Milton Russell, E. William Colglazier, and Mary R. English, *Hazardous Waste Remediation: The Task Ahead* (Knoxville, Tenn.: University of Tennessee, Waste Management Research and Education Institute, 1991); and Office of Technology Assessment, *Coming Clean: Superfund Problems Can Be Solved . . .* (October 1989).

2. For example, the issue of permanent isolation as an alternative to cleanup has been raised for some remote and technically difficult sites in the Energy Department's nuclear weapons complex. Conversely, the controversies surrounding the Superfund liability system generally do not apply to federal sites. For analyses of cleanup problems at federal facilities, see Congressional Budget Office, *Cleaning Up the Department of Energy's Nuclear Weapons Complex* (forthcoming), "Environmental Cleanup Issues Associated with Closing Military Bases," CBO Staff Memorandum (August 1992), and *Federal Liabilities Under Hazardous Waste Laws* (May 1990); and Office of Technology Assessment, *Complex Cleanup: The Environmental Legacy of Nuclear Weapons Production* (February 1991).

3. National Research Council, Committee on Environmental Epidemiology, *Environmental Epidemiology*, vol. 1, *Public Health and Hazardous Wastes* (Washington, D.C.: National Academy Press, 1991).

stances.⁴ The program is administered by the Environmental Protection Agency (EPA), which evaluates the need for cleanup at sites brought to its attention, identifies parties liable for the costs of cleanup, and oversees site studies and cleanups conducted either by its own contractors or by the liable parties. Funding for these EPA activities comes primarily from specific business taxes earmarked for a trust fund, officially named the Hazardous Substance Superfund.

Superfund was created by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) to complement other federal environmental laws that emphasize reducing new emissions of hazardous substances or cleaning up narrower categories of sites (see Box 1). The Congress amended the program, greatly increasing the size of the trust fund, in the Superfund Amendments and Reauthorization Act of 1986 (SARA). In 1990, the Congress renewed Superfund for fiscal years 1992 through 1994 and extended its taxation authority through calendar year 1995.

What Does the Superfund Program Do?

The Superfund program focuses on two types of waste-hazard cleanups: removal actions and remedial actions. Removal actions include emergency responses to immediate threats (from spills or leaking barrels, for example) and limited, interim steps toward full cleanup (such as draining a surface lagoon). Under SARA, removals financed by the federal government are limited to one year and \$2 million unless EPA finds that continued action is immediately necessary or is appropriate and consistent with its plans for subsequent remediation. (The ceilings on duration and cost do not apply to removal actions undertaken by liable private parties.) For many sites, removals are sufficient to complete the necessary cleanup.

Sites that are more costly to clean up and pose large enough threats to human health and the environment can be placed by EPA on the National Priorities List for remedial response. Examples of remedial cleanups include capping and monitoring landfills, excavating and disposing of river sediments, pumping and treating groundwater, and incinerating or biologically treating soils. A significant policy change introduced in SARA requires EPA to give preference to remedial treatments that permanently and significantly reduce the volume, toxicity, or mobility of the hazardous substances, especially over remedial options that involve off-site disposal of untreated substances.

EPA selects sites for the NPL using a multistage screening process that culminates in a score under the Hazard Ranking System (HRS). Each site brought to EPA's attention--typically by a state or local government, site owner, or neighbor--first receives a preliminary assessment (PA), which includes a review of available documents and reconnaissance of the site. A site that is neither eliminated from further consideration after the PA nor referred to another cleanup program receives a site inspection (SI), which involves collecting and analyzing samples of soil and water, as appropriate. In some cases, the SI is supplemented by an expanded site inspection, which yields more data. Finally, EPA uses the collected data to assign the site an HRS score; in general, a site is placed on the NPL if it scores at least 28.5.⁵

The National Priorities List is itself a multistage process, commonly called a pipeline. Once a site is on the list, it passes through several major phases or milestones.

- o The remedial investigation and feasibility study (RI/FS) maps out the nature and extent of a site's waste hazards and evaluates alternative responses.

4. The term "hazardous waste" is given a specific legal definition in the Resource Conservation and Recovery Act (42 U.S.C. 6903, 90 Stat. 2799). Superfund cleanups can be triggered by a broader class of substances, some of which can be considered products or feedstocks rather than wastes.

5. One site in each state may be placed on the NPL, regardless of its HRS score, by being designated the top priority of the state government. Also, a rarely used mechanism allows a site to be placed on the NPL if the Agency for Toxic Substances and Disease Registry issues a health advisory recommending that people be removed from the site. Some sites that would score above 28.5 are referred to another cleanup program (see Box 1) instead of being placed on the NPL.

Box 1. Other Federal Laws Governing Cleanup

The Resource Conservation and Recovery Act of 1976 (RCRA), which amended the Solid Waste Disposal Act of 1965, established in its Title C a national program for tracking and managing hazardous wastes and a corrective action program requiring cleanup of such wastes released into the environment at treatment, storage, or disposal (TSD) facilities, which include many industrial plants. The corrective action program is defined more narrowly than the Superfund program, which covers a broader class of hazardous substances and is not limited to releases occurring at facilities; also, some TSD facilities are likely to end up as Superfund sites because their owners and operators are unable or unwilling to comply with the corrective action requirements. Nonetheless, the large number of TSD facilities potentially requiring cleanup may make total cleanup costs under RCRA higher than under Superfund.

The initial RCRA statute did not direct the Environmental Protection Agency (EPA) to regulate underground storage tanks containing chemical products as opposed to wastes; nor did the 1980 Superfund law authorize the agency to clean up leaks of petroleum and petroleum products (which are generally excluded from the Superfund definition of hazardous substances) from such tanks. These gaps in authorization were filled in 1984 and 1986. Among the many changes made to RCRA by the Hazardous and Solid Waste Amendments of 1984 were provisions requiring EPA to set standards for the design, operation, and cleanup of underground tanks containing petroleum or hazardous products. Authorization for EPA to clean up leaks from petroleum tanks was included in the 1986 amendments to Superfund, which also created a smaller Leaking Underground Storage Tank Trust Fund to finance such cleanups.

The Clean Water Act, formally the Federal Water Pollution Control Act Amendments of 1972, created the federal authority to regulate cleanup of oil spills that pose a threat to surface water. The Oil Pollution Act of 1990 authorized using the existing Oil Spill Liability Trust Fund to pay for cleanup, raised

existing limits on spillers' federal liability, and authorized the Coast Guard to require that owners and operators of oil-related facilities and vessels have plans for containing and removing such spills in coastal areas.

The 1976 Toxic Substances Control Act (TSCA) authorized EPA to regulate both the use, labeling, and disposal of new and existing chemicals used in manufacturing and commerce and the cleanup of spills of polychlorinated biphenyls (PCBs). The Asbestos Hazard Emergency Response Act amended TSCA in 1986, adding requirements that EPA set standards for cleaning up asbestos in school buildings. Superfund cleanups must meet the TSCA standards where applicable or "relevant and appropriate."

The Surface Mining Control and Reclamation Act of 1977 established a permitting program in the Department of the Interior to require active coal-mining operations to meet environmental and reclamation standards. It also placed a tax on current coal production to fund reclamation of mines abandoned before 1977 or before enactment of the regulations implementing the law. The tax money, however, cannot be used to clean up mines for which a responsible former operator could pay; in such cases, cleanup can proceed only under Superfund or state authorization. Amendments passed in 1990 also prohibit this money from being used to clean up mines listed as NPL sites, even if no solvent operators exist.

The Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA) directed the Department of Energy to clean up sandlike tailings left from uranium-processing operations at 24 specific inactive sites. These sites are excluded from the Superfund program, as are any releases of radioactive substances from nuclear power plants. Other radioactive wastes, including uranium tailings at milling sites not included in the UMTRCA list, can be cleaned up under either Superfund or the Atomic Energy Act of 1954, as amended.

- o The record of decision (ROD) documents EPA's selection of a particular remedy.
- o The remedial design (RD) develops the detailed engineering plan for carrying out the selected remedy.
- o The remedial action (RA), which often includes "construction" and "operations and maintenance" phases, is the actual implementation of the remedy.

This description of the NPL pipeline requires two qualifications. First, many sites are divided into multiple "operable units" that correspond to different areas or media to be cleaned up and that undergo the RI/FS-ROD-RD-RA sequence separately. A site's surface soil and groundwater might constitute two operable units, for example. Second, a site or operable unit that has reached a given stage in the pipeline may return to an earlier stage as a result of further evaluation or new information.

Besides these screening, study, and cleanup efforts at individual sites--sometimes called direct response activities--many technical, legal, and managerial activities in both the public and private sectors are part of the Superfund program. The liability system, discussed next, spurs searches for liable parties and negotiation and litigation over cleanup work and cost allocation. Other activities include research and development, technology dissemination, laboratory analysis, community relations, technical assistance grants, contract management, policy development, and budget planning.

Who Pays for Superfund Cleanups?

CERCLA takes a two-pronged approach to the problem of who should pay to clean up hazardous waste sites: it makes four types of parties liable for the costs of cleanup, and it establishes the Superfund trust fund to finance responses at sites for which the liable parties cannot be found or lack sufficient resources. The four types of "responsible parties" (RPs) are a site's present owners and operators, its previous owners and operators from periods during which it received hazardous substances, the genera-

tors of such substances, and any waste transporters responsible for choosing the site.⁶

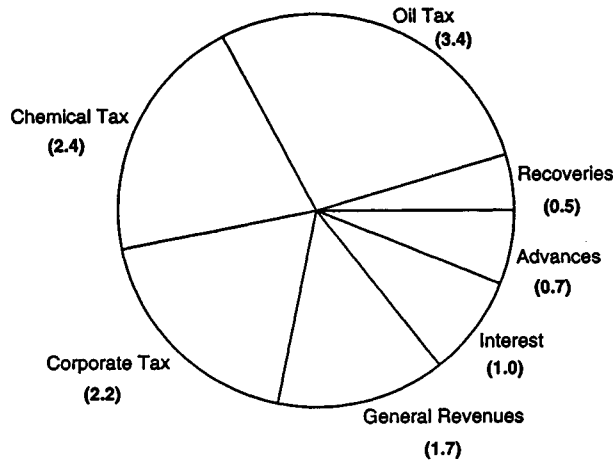
Liability under CERCLA is retroactive, strict, and joint and several. Strict liability places responsibility without regard to care or negligence; for example, a party cannot escape Superfund liability by showing that its waste disposal practices obeyed all laws and regulations that were in force at the time. Joint-and-several liability means that any responsible party can be assessed the total costs for a contaminated site (unless his or her contribution can be shown to have produced a separate, divisible result). This liability scheme serves two goals of Superfund's designers: it minimizes the ultimate burden on federal taxpayers, and it gives handlers of hazardous substances additional reason to avoid creating future hazards.

In administering the Superfund program, the Environmental Protection Agency can enforce the liability of responsible parties in either of two ways. It can have them perform the necessary cleanup directly, under government supervision; such "RP-lead" or "enforcement-lead" cleanups can occur either through a negotiated settlement or as a result of an administrative or judicial order. Alternatively, EPA can conduct the cleanup itself and then negotiate or sue to recover its costs from the responsible parties after the fact. Such cleanups are referred to as "fund-lead."

Fund-lead cleanups and other federal Superfund expenditures are financed with money appropriated from the trust fund, which receives most of its revenue from excise taxes on petroleum and certain chemicals and a tax on corporate income. In fiscal year 1992, these taxes brought in \$1.2 billion; cumulatively, they account for \$8 billion of the \$12 billion in total Superfund receipts through 1992, or 67 percent (see Figure 1). Other sources of money to the trust fund are general Treasury revenues (14 percent of the total), interest on the fund balance (8

6. Because liability is often contested, the term "potentially responsible parties" is also commonly used. The present study follows the EPA style in referring to "RP-lead" cleanup and study projects; no confusion is intended with the definition of "responsible party" used in the Oil Pollution Act.

Figure 1.
Cumulative Trust Fund Resources,
Fiscal Years 1981-1992
(In billions of dollars)



Total Receipts: 12.0

SOURCE: Congressional Budget Office based on data from the Department of Treasury.

percent), repayable advances from the general fund (6 percent), and recoveries, fines, and penalties from responsible parties (5 percent).

One important difference between fund-lead and RP-lead cleanups is that the state in which a site is located is required to share the cost of a fund-lead cleanup. States pay 10 percent of costs for the construction phase of a remedial action (50 percent or more for sites that were operated by the state or a local government during the disposal of hazardous substances) plus all maintenance of the remedy. In carrying out this provision of the law, EPA defines the first 10 years of pump-and-treat remedies (commonly used in cleaning groundwater) as long-term remedial actions, requiring only the 10 percent state contribution, rather than as maintenance.

EPA has de-emphasized the fund-lead option since 1989, when it adopted its "enforcement-first" policy. Under that policy, the agency seeks to maximize cleanups by responsible parties (thus minimizing demands on the trust fund and the need for cost recovery) by routinely issuing administrative

orders to compel cleanup when settlements are not reached by the end of the statutory moratorium for negotiations. More recently, EPA has announced efforts to encourage settlements by increasing its use of some of the incentives and negotiating tools authorized in SARA.

Progress of Cleanups to Date

Although few NPL sites have been completely cleaned up in Superfund's first 12 years, the program's record of accomplishment is arguably better than its image would suggest. EPA has evaluated close to 24,000 nonfederal sites for possible inclusion on the NPL and has begun evaluating another 9,000 sites. Combined, these cases represent 94 percent of the nonfederal sites that had been brought to the agency's attention through fiscal year 1992. Together with cooperating responsible parties, EPA has finished 2,639 removal actions at 2,142 nonfederal sites--431 NPL sites and 1,711 non-NPL sites. Also, EPA has placed 1,149 nonfederal sites on the proposed or final NPL and has started one or more stages of the remedial pipeline at all but 56 of these sites. (The NPL also includes 126 federal sites, of which 116 have begun one or more stages of the remedial pipeline. Through 1992, 56 removal actions had been completed at 21 federal NPL sites.)

Measuring progress at sites once they have entered the NPL pipeline is complicated by the common EPA practice of dividing sites into operable units. Agency statistics typically report cleanup status in terms of the progress of each site's most advanced operable unit. Hence, reporting that 1,093 nonfederal NPL sites (95 percent of the total) were at or beyond the remedial investigation/feasibility study stage at the end of 1992 really means that 1,093 sites had started (if not completed) at least one RI/FS, but not necessarily all of the RI/FSs required for the site. Other EPA statistics as of the end of 1992 show that the most advanced operable unit

- o had passed the record-of-decision stage at 766 sites (67 percent);
- o had reached or passed the remedial design stage at 698 sites (61 percent); and

- o had reached or completed the remedial action stage at 501 sites (44 percent).⁷

These statistics do not reveal how much of the work remains to be done at the 1,149 sites, however, because they do not indicate the number of operable units into which the sites will ultimately be divided.

One statistic on NPL progress that encompasses all of a site's operable units is the number of construction completions. EPA is still refining the definition of this term; it currently includes sites deleted from the list after the completion of all necessary response actions (other than routine operation and maintenance of the remedy), sites awaiting formal deletion, and sites at which all remedies are in place but long-term operations and maintenance are ongoing. (Pump-and-treat operations to clean groundwater, for example, may require 30 years or more to attain the cleanup goals.) At the end of fiscal year 1992, EPA counted 148 nonfederal sites as construction completions--up sharply from 63 the previous year but still less than 13 percent of the nonfederal NPL. Of these 148 sites, 40 have been deleted from the list, 83 are awaiting deletion, and 25 are undergoing long-term remediation.⁸

Controversies and Options

Since its inception, Superfund has been subject to many criticisms, not all of them consistent. Some of the more common criticisms, outlined below, reflect dissatisfaction with the program's overall ratio of benefits to costs; others primarily involve the distri-

bution of the benefits and costs among affected parties.

Slow Pace of Cleanup. The view that NPL sites are not getting cleaned up fast enough can be argued by referring to the above figures on deleted sites and construction completions. Alternatively, critics can point to the durations of average cleanup projects, which have risen steadily in recent years. At the end of 1992, EPA estimated that the average operable unit takes nine years and four months from the start of its remedial investigation/feasibility study to the completion of its remedial action. This figure suggests that the average time per site between placement on the NPL and completion of cleanup construction at the last operable unit may be about 12 years.

Unfairness. Superfund's liability system has been criticized as unfair on various grounds. Some observers argue that the fundamental concept of retroactive liability (or retroactive liability for actions that are not negligent) is unjust. Others claim that retroactivity can be justified but that joint-and-several liability is unfair. A third position says that a basically fair liability scheme is being wrongly interpreted in cases involving specific types of parties--particularly local governments, lenders, or contributors of very small volumes of waste.

Litigiousness. Another criticism of the liability system focuses on the transaction costs incurred in assigning and allocating liability.⁹ Among these are the costs of negotiations and litigation among a site's potentially responsible parties, between the parties and EPA, and between the parties and their insurers. EPA's efforts to identify and locate responsible parties and to gather site data suitable for use in litigation are also transaction costs; so are unofficial RI/FSs conducted by responsible parties as a check on EPA's own work and the additional layer of oversight involved when both RPs and EPA monitor the work of contractors performing RP-lead cleanups.

7. These pipeline statistics include sites at which an operable unit skipped over the indicated stage rather than passing through it. A few early sites went directly to remediation without going through the RI/FS and ROD steps. Other sites are counted as being past the remedial design stage because a "no-action" ROD for one of their operable units indicated that no further cleanup (and hence no design work) was necessary.

8. In addition, one federal NPL site awaits deletion. A recent review by the General Accounting Office reported that 23 of the 149 cases are sites that received neither removal nor remedial action because EPA found that they posed no threat to health or the environment and had been listed on the NPL in error (because of mistakes in sampling, for example). Another 28 NPL sites had reached construction completion based on removal actions alone. See General Accounting Office, *Superfund: Cleanups Nearing Completion Indicate Future Challenges* (September 1993).

9. Economists define transaction costs as those costs incurred in order to engage in a transaction (such as the costs of search time, bidding, and contracting) in contrast to the costs of the goods or services actually exchanged. The Superfund case stretches the term a bit: in this context, the "transactions" are not trades in the marketplace but legal assignments and allocations of liability.

Selection of Inappropriate Remedies. Several competing criticisms allege that too many of EPA's Superfund remedies are inappropriate. Some people fault the remedies primarily for insufficient thoroughness and permanence. Others argue that many remedies are excessively thorough and hence too expensive, sometimes because EPA's assumptions about human exposure to a site's hazardous substances are based on unrealistic scenarios for future land use. A third perspective focuses less on the results of the remedy selections than on the process, arguing that EPA's decisions should take more account of the desires of affected local communities.

Low Environmental Priority. The above criticisms regarding slow cleanups, litigiousness, and inappropriate remedies can be interpreted as arguments that Superfund's benefits are lower than they could be or that its costs are higher than necessary. Another criticism holds that even if the above issues were resolved, a more fundamental cost-benefit problem would remain. In this view, hazardous wastes represent a relatively low risk to humans and the environment (compared with other threats such as indoor radon exposure, pesticide residues on foods, non-point-source water pollution, and tropical deforestation) and should fall much lower on the nation's list of budget priorities.

These criticisms have led to a wide variety of proposals for reforming Superfund. Among the options under discussion are the following:

- o reducing the emphasis on joint-and-several liability, with increased government funding to pay the shares of liable parties who are bankrupt or cannot be identified; and
 - o capping liability for municipalities or eliminating liability for contributors of very small volumes of waste.
- The estimates given in this study do not evaluate Superfund costs under any of these alternative policies, but they do provide a baseline against which the changes could be compared. The baseline itself can help to indicate whether the remaining Superfund problem is large enough to justify the near-term costs of disruption involved in changing to a new policy regime.
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- ## Types of Costs and Expenditures to Date
- The Superfund costs included in this study are those incurred by the private sector and federal and state governments for both site cleanup work and ancillary activities. The Congressional Budget Office (CBO) estimates that nominal-dollar outlays (that is, actual spending) by private parties and state governments over Superfund's first dozen years were roughly \$6.3 billion and \$0.1 billion, respectively. Firmer figures indicate that the federal government spent \$7.0 billion, excluding costs fronted or reimbursed by liable parties. Cumulative obligations--immediate or multiyear spending commitments--may be on the order of \$20 billion for all payers combined.
- As noted earlier, the figures considered here do not include the costs of cleaning up federal facilities. (In 1992, the environmental restoration programs of the Departments of Defense and Energy obligated on the order of \$3 billion, roughly equaling the combined public and private Superfund obligations.) Two other types of costs that might be attributed to the program are also not covered: Superfund-induced spending on hazard prevention is excluded for lack of data, as are the economic costs of loans not made and properties not resold or reused because of concerns about potential Superfund liability.

Federal Expenditures

Total federal Superfund outlays over the program's first 12 years were \$7.7 billion in nominal terms, or \$8.6 billion in constant 1992 dollars (see Table 1). These totals include \$0.5 billion (nominal) subsequently recovered from responsible parties and \$0.2 billion funded by cash-out settlements, in which RPs settle their liability by paying in advance for cleanup work to be done by EPA.¹⁰ Cumulative obligations were \$10.5 billion and \$11.9 billion in nominal and 1992 dollars, respectively. Both measures of costs grew sharply in the initial years after SARA, when the Congress authorized a fivefold increase in the size of the trust fund. In 1992, annual outlays and obligations reached new highs of \$1.5 billion and \$1.7 billion.¹¹

The \$1.7 billion in 1992 Superfund obligations represents roughly one-quarter of EPA's total budget. EPA addresses most other environmental problems through regulation rather than direct government action; accordingly, Superfund obligations greatly exceed the amounts spent by the agency on other problems. An EPA analysis of its 1992 budget request found \$450 million targeted for air pollution, for example, \$109 million for pesticide problems, and \$28 million for indoor radon exposure. The Superfund budget was second only to the \$2.1 billion for treatment of point-source water problems, most of which constituted grants to the states for constructing municipal wastewater treatment plants.¹²

If 1992 Superfund obligations are classified according to the categories used in this study for estimates of future costs, direct response costs account for 52 percent of the program's budget (see

Table 1.
Federal Superfund Outlays and
Obligations, Fiscal Years 1981-1992
(In thousands of 1993 dollars)

	Outlays	Obligations ^a
1981	8,039	40,283
1982	79,576	180,114
1983	150,214	227,199
1984	285,471	453,818
1985	363,023	455,485
1986	442,352	359,927
1987	544,890	1,039,451
1988	832,870	1,456,350
1989	964,978	1,522,681
1990	1,160,459 ^{b,c}	1,484,947 ^{b,d}
1991	1,431,608 ^{b,c}	1,589,557 ^{b,d}
1992	1,466,507 ^{b,c}	1,737,340 ^{b,d}
Total	7,729,987	10,547,152
Approximate Total in 1992 Dollars	8,610,000	11,875,000

SOURCE: Congressional Budget Office based on data from the President's budget, various years.

NOTE: Figures were derived by subtracting from total outlays and obligations those related to contaminated federal facilities for which the Environmental Protection Agency was reimbursed by other agencies.

- a. Net of recoveries of prior-year obligations not spent.
- b. The reimbursements from other federal agencies that were subtracted in this case are CBO estimates.
- c. Includes outlays for the Office of Inspector General from Treasury Department reports on the Superfund trust fund.
- d. Includes obligations for the Office of Inspector General from the President's budget.

10. The totals exclude an estimated \$0.1 billion in Superfund outlays reimbursed by other federal agencies for such activities as assistance in setting up data systems for hazardous waste sites. The figure of \$7.0 billion in nominal federal outlays avoids double-counting by also excluding RP payments.

11. Table 1 shows 1992 obligations of \$1.737 billion, well above the 1992 appropriation of \$1.615 billion. This high-water mark was reached with the aid of a high level of cash-out settlements, which appear as offsetting collections in the budget and are not subject to the appropriation process.

12. Environmental Protection Agency, Office of Policy, Planning, and Evaluation, "Environmental Problem Area Profiles" (July 20, 1991).

Table 2).¹³ Total site-based costs are arguably as high as 59 percent when laboratory analysis, site mapping, compensation of EPA workers who oversee site cleanups, and services of the Army Corps of Engineers and Bureau of Reclamation are included.

13. The data in Table 2, based on an internal EPA management report, yield higher total obligations than those shown in Table 1, primarily because they do not subtract funds recovered by canceling previous obligations.

Table 2.
Superfund Obligations in Fiscal Year 1992

Type of Cost	Millions of Dollars	Percentage of Superfund Budget
Direct Response		
Screening	81.9	5
Removals	199.8	11
Remedial investigations/feasibility studies	70.5	4
Remedial designs ^a	62.8	3
Remedial actions ^a	515.0	29
Subtotal	930.0	52
Response Support		
OSWER salaries, excluding enforcement ^b	68.0	4
Remedial support ^{b,c}	75.2	4
Removal support ^{b,d}	54.1	3
Laboratory analysis	44.8	2
Other EPA support ^e	9.5	f
Supporting federal agencies ^g	65.3	4
Subtotal	317.0	18
Enforcement		
Oversight of RP-lead RDs and RAs ^a	36.7	2
Office of Waste Programs Enforcement	124.7	7
EPA Offices of Enforcement, General Counsel ^h	77.4	4
Department of Justice ⁱ	32.3	2
Subtotal	271.1	15
Research and Development		
EPA research and development	68.0	4
National Institute of Environmental Health Sciences ^b	51.1	3
Subtotal	119.1	7
Management and Administration		
OSWER management ^{b,j}	43.1	2
General administration ^k	100.8	6
Office of Inspector General ^l	13.2	1
Subtotal	157.1	9
Total	1,794.3	100

SOURCE: Congressional Budget Office using data from the Environmental Protection Agency's (EPA's) final 1992 Superfund budget, except where noted.

NOTE: OSWER = EPA Office of Solid Waste and Emergency Response; RP = responsible party; RD = remedial design; RA = remedial action.

- a. Obligations for oversight of RP-lead projects were estimated by applying percentage shares from EPA's 1993 budget justification to the 1992 totals.
- b. Estimated by combining final 1992 figures with percentage shares from the earlier 1992 operating plan.
- c. Includes administrative costs of cleanup contractors, services from the Army Corps of Engineers and Bureau of Reclamation, technical assistance grants to local communities, state grants, contractor services for mapping and for support of policy development, and so on.
- d. Includes contractor services for technical assistance, support of policy development and waiver requests, and so on.
- e. Includes the EPA Offices of Water, Air, and Radiation; Policy, Planning, and Evaluation; and the Administrator.
- f. Less than 0.5 percent.
- g. Includes the Agency for Toxic Substances and Disease Registry, Coast Guard, National Oceanic and Atmospheric Administration, Federal Emergency Management Agency, Department of the Interior, and Occupational Safety and Health Administration.
- h. Includes an estimated \$33 million (2 percent) for the EPA Office of Federal Facilities Enforcement.
- i. Taken from the 1992 operating plan in EPA's 1993 budget justification.
- j. Includes contractor services, computer time, and equipment purchases for training, budgeting, planning, dissemination of new technologies, emergency preparedness, and so on.
- k. Includes rent, utilities, financial management, contract management, computer services, and so on.
- l. Actual 1992 obligations from the President's 1994 budget request.

Enforcement costs account for 15 percent of the total, including 2 percent for oversight of RP-lead remedial designs and remedial actions. As noted before, the additional level of oversight involved in RP-lead projects is one source of transaction costs resulting from the enforcement system.

Most of the Superfund budget is spent outside EPA; the agency relies extensively on external contractors to supplement its own work force. All of the costs shown in Table 2 for direct response, remedial support, removal support, laboratory analysis, oversight of RP-lead RDs and RAs, and Office of Solid Waste and Emergency Response (OSWER) management are dollars spent on external services and purchases, as are the majority of funds for the OSWER Office of Waste Programs Enforcement. These external costs account for an estimated \$1.3 billion, or 91 percent of the OSWER Superfund total of \$1.4 billion. Taking EPA's Superfund budget as a whole (including the non-OSWER costs for general administration, research and development, enforcement, and support), the 1992 appropriation guaranteed that external costs would be at least 84 percent of the total by capping internal costs at roughly 16 percent.

State and Private Expenditures

State and private-sector Superfund spending is easier to classify than federal spending but harder to estimate. State costs related to the federal program are largely the required contributions for remedy construction and operations and maintenance (O&M) at fund-lead sites, and EPA does not directly monitor the O&M costs. The estimate of \$0.1 billion in state costs to date comes from a 1991 EPA estimate of \$40 million (in 1990 dollars) for cumulative O&M costs through 1992 plus the observed \$76 million (in nominal dollars) paid to the agency as matching shares of construction costs. (Many states also have their own cleanup programs, which incur a full range of legal and administrative expenses. The costs of these programs are not included here.) EPA spent \$2.6 billion on remedial actions over the same period, according to agency data, including roughly

\$0.1 billion to \$0.2 billion for oversight of RP-lead actions; the \$76 million in state matching contributions therefore represents only 3 percent of total public spending on construction of fund-lead RAs. The gap between this 3 percent and the statutory 10 percent requirement is explained by EPA's willingness to negotiate multiyear or deferred payment plans with the states.

Total Superfund costs to the private sector include three components:

- o payments made to the government for fines, penalties, cash-out settlements, and recoveries of fund-lead expenditures;
- o costs of RP-lead cleanup studies and actions; and
- o transaction costs incurred by responsible parties and their insurers in efforts to minimize their individual liability.

EPA does not directly observe the second and third types of costs. The agency estimates the value of RP cleanup commitments but does not require RPs to report how closely actual spending matches its estimates; nor does it track private transaction costs. The directly observed costs for fines, penalties, cash-out settlements, and cost recoveries represent only the tip of the iceberg of total private Superfund costs. Moreover, these costs are mere "transfer payments"--in that they do not reflect additional costs to the economy as a whole but only a shift of funds from the private sector to the government--and thus are irrelevant to an analysis of total Superfund costs.

The rough figure of \$6.3 billion in private-sector costs to date comes from an observed \$0.5 billion in cost recoveries and estimates of approximately \$3.7 billion in RP-lead cleanup projects and \$2.0 billion in transaction costs. The \$3.7 billion figure for cleanup costs was derived by assuming that EPA's estimated value of almost \$7.5 billion in responsible-party work commitments accurately predicts dollar outlays--in effect, assuming that any cost savings from private-sector efficiencies balance any increases from underestimating the scope of the cleanup

problems--and that half of the commitments remain to be spent over the next five years.¹⁴

The estimate of \$2.0 billion in transaction costs was extrapolated from data in a recent RAND study of five large industrial RPs and four property/casualty insurers.¹⁵ The RAND study found that 17 percent of the dollars spent through 1989 by the responsible parties at sites with total expenditures over \$100,000 were transaction costs. CBO assumed that this ratio applies to expenditures by all RPs through 1992; with estimated RP spending on non-transaction costs totaling \$4.1 billion (including payments to EPA but excluding cleanup work funded by RPs' insurers), their estimated transaction costs are $\$4.1 \times 0.17 / (1 - 0.17) = \0.8 billion.¹⁶

The RAND study also estimated that the insurance industry as a whole spent \$410 million in 1989 on transaction costs at all hazardous waste sites. Of this total, an estimated 40 percent was sparked by NPL sites and 60 percent by non-NPL sites, including Superfund removal sites. Also, 21 percent of costs resulted from claims for bodily injury and property damage rather than claims for cleanup costs under CERCLA. CBO assumed that 1989 costs represented one-seventh of the total between 1981 and 1992 (because costs in the early years were relatively low) and that NPL and Superfund removal sites together accounted for \$210 million in 1989 insurer transaction costs--roughly half of the total. Subtracting the costs related to injury and damage claims, this yields $\$0.21 \times 7 \times (1 - 0.21) = \1.2 billion.

14. Given the time required for engineering design before a remedy can be carried out, the following five-year spendout pattern was assumed: zero the first year, 20 percent each in the second and third years, and 30 percent each in the fourth and fifth years.

15. Jan Paul Acton and Lloyd S. Dixon, *Superfund and Transaction Costs* (Santa Monica, Calif.: RAND, 1992).

16. A follow-up study restricted to 18 NPL sites suggests that smaller firms might have higher shares of transaction costs and that the national average might be 32 percent. See Lloyd S. Dixon, Deborah S. Drezner, and James K. Hammitt, *Private-Sector Cleanup Expenditures and Transaction Costs at 18 Superfund Sites* (Santa Monica, Calif.: RAND, 1993).

Other Groups' Estimates of Superfund Costs

The EPA and a group of researchers at the University of Tennessee have also produced estimates of future Superfund costs. These estimates are not comparable with each other, however, nor are they as comprehensive as the ones presented here.

In its annual report to the Congress on Superfund for 1990 (the most recent available), EPA projected funding requirements of \$16.4 billion in fiscal years 1993 and beyond and a cumulative total since 1981 of \$27.2 billion. These estimates are restricted to costs incurred by the federal Superfund budget and exclude costs for cleaning up future NPL sites (that is, sites not listed at the end of fiscal year 1990).

The University of Tennessee researchers released reports in December 1991 that contained a "best-guess" estimate of \$151 billion for cumulative costs to clean up 3,000 nonfederal NPL sites.¹⁷ The Tennessee studies examined the implications of alternative cleanup policies, estimating that greater use of containment methods could reduce future costs to \$90 billion, and that greater reliance on treatment methods could raise them to \$352 billion. These figures cover a different set of costs than does the smaller EPA estimate: they include state and private remediation costs for NPL sites as well as federal costs, but they omit expenditures on non-NPL removal sites and EPA's enforcement and management activities.

The present CBO study seeks to improve on its EPA and Tennessee predecessors in four ways. First, it covers a broader range of costs, including state and private-sector cleanup expenditures and the costs associated with future NPL sites (excluded from the EPA estimate), federal implementation costs (not

17. See Russell, Colglazier, and English, *Hazardous Waste Remediation*; and E. W. Colglazier, T. Cox, and K. Davis, *Estimating Resource Requirements for NPL Sites* (Knoxville, Tenn.: University of Tennessee, Waste Management Research and Education Institute, 1991).

covered in the Tennessee study), and private transaction costs (omitted from both). Second, because a relatively few "mega-sites" have had a major impact on Superfund costs to date, CBO's estimate incorporates possible trends in the average characteristics of future NPL sites. Third, cumulative future expenditures are reported in discounted, present-worth dollars, which take into account the time value of

money and thereby provide a more useful measure of the expenditures' cost to the economy. Fourth, CBO's analysis of average cleanup costs incorporates recent EPA data on the differences between initial estimates and final costs and allows for the possibility that private-sector cleanups may cost less than those performed by the government.